CHAPTER 4

TELETYPE AND FACSIMILE

The teletypewriter is little more than an electrically operated typewriter. The prefix "tele" means "at a distance." Coupled with the word "typewriter" it forms a word meaning "typewriting at a distance." By operating a keyboard similar to that of a typewriter, signals are produced that cause the teletypewriter to print the selected characters (letters, figures, and symbols). The characters appear at both sending and receiving teletypewriters, and one teletypewriter actuates as many machines as may be connected together.

To see how intelligence is sent by teletypewriter, let us consider one of the simpler devices for electrical communication: the manual telegraph circuit. In this series or loop-connected circuit, shown in figure 4-1, we have a telegraph key, a source of power (called battery), a telegraphic sounder, and a movable sounder armature. If the key is closed, current flows through the circuit and the armature is attracted to the sounder by magnetism. This action causes a clicking sound. When the key is opened, current stops flowing and the armature returns to its original position. With these two electrical conditions of the circuit—closed and open—it is possible, by means of a code, to transmit intelligence.

The telegraph circuit in figure 4-1 can be converted to a simple teletypewriter circuit by substituting a transmitting teletypewriter for the key at station A, and a receiving teletypewriter for the sounder at station B. This arrangement for a given word-per-minute system is shown in figure 4-2. In the teletypewriter circuit each current and no current interval consumes a set period of time, whereas in the telegraph circuit these time intervals vary with the code being transmitted by the operator.

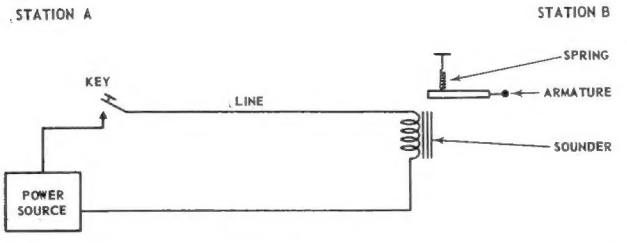

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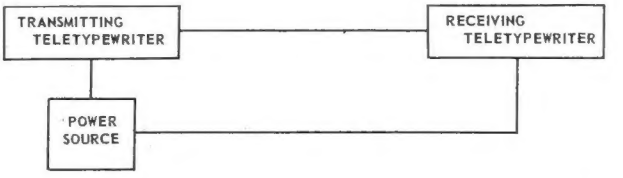
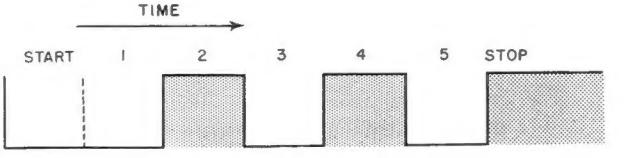
Figure 4-1.—Manual telegraph circuit.



1.200

Figure 4-2.—Simple teletypewriter circuit.

A teletype signal can be represented as mark and space pulses as shown in figure 4-3. Shaded areas show intervals during which the circuit is closed, and the blank areas show the intervals during which the circuit is open. A closed circuit produces a mark and an open circuit produces a space. The signal contains a total of seven units. Five of these are numbered, and are called "intelligence" units. Various combinations of marks and spaces in the intelligence units represent different characters. The first and last units



1.197

Figure 4-3.—Mark and space signals in the teletypewriter character R.

of the signal, labeled start and stop, are named after their functions: the first starts the signal and the last stops it. These are a part of every teletype code character, and are the means by which the teletypewriter machines and signals are kept in synchronization with each other.

When the sending and receiving teletypewriters are wire connected, the exchange of intelligence between them is direct. But when the teletypewriters are not joined by wire, operation is more complex. Direct-current mark and space intervals cannot be sent through the air. The gap between the machines must be bridged by radio.

RADIOTELETYPE (RATT) SYSTEMS

The Navy uses two basic teletype systems aboard ship. One is the audio frequency tone-shift radioteletype (AFTSRATT) used for short range operation and similar to the familiar AM radio method of broadcasting. The other is the radiofrequency carrier-shift radioteletype (RFCSRATT) used for long range operation and similar to the familiar FM radio communications.

TONE-SHIFT MODULATION SYSTEM

A teletypewriter, a tone converter, and a transmitter are used to transmit messages by the tone-shift modulation method. The teletypewriter sends out a DC signal. The signal is changed to audio tones in the tone-shift converter. The transmitter impresses the audio tones on the carrier and sends out a tone-shift modulated carrier wave (fig. 4-4A).

To receive messages with the tone-modulated system, a radio receiver, a tone-shift converter, and a teletypewriter are required. The tone-shift modulated carrier wave enters the receiver, which extracts the signal intelligence and sends the audio tones to the tone-shift converter. The converter changes the audio tones into DC mark and space pulses for the teletypewriter (fig. 4-4B).

In practice, the same tone terminal is used for the receiving and the sending circuits inasmuch as it contains both a transmit keyer unit and a receiver unit.

FREQUENCY CARRIER-SHIFT SYSTEM

At the transmitting end of the long-range frequency carrier-shift system (fig. 4-4C) is a teletypewriter, a transmitter, and a frequency shift keyer unit. The keyer unit is built into the newer transmitters, but in some older systems it is separate equipment. When the teletypewriter is operated, the DC mark and space signals are changed by the keyer unit into audiofrequency carrier-shift output signals. This AFCSRATT is transmitted by conventional Navy transmitters.

On the receiving side of the long-range system (fig. 4-4D) is a receiver, a frequency carrier-shift converter, and a teletypewriter. When the frequency carrier-shift signal enters the receiver, it is detected and changed into corresponding frequency carrier-shift audio signals. The audio output of the receiver is fed to the converter, which changes the carrier-shift audio signals into DC mark and space signals.

In both the tone-shift system and the carrier-shift system, all teletypewriter signals pass through the teletypewriter panel that controls the looping current in all the circuits. As illustrated in figure 4-5, the teletypewriter (RATT) panel patches the tone-shift modulated system or the frequency carrier-shift system. It provides every possible RATT interconnection available onboard ship. This operational flexibility gives maximum efficiency with the fewest circuits and the least amount of equipment in the Navy's compact RATT systems afloat.

TELETYPE EQUIPMENT

Because of the increasing variety of teletype equipment installed aboard ship, it is impractical to describe every piece of equipment you are likely to encounter. The equipment discussed in the ensuing paragraphs, however, is representative of the types commonly employed in shipboard installations. In some instances, this same equipment may be designated by nomenclature different from that given in this text. But, in most of these instances, this variance in nomenclature merely indicates a modification of the basic equipment described herein.

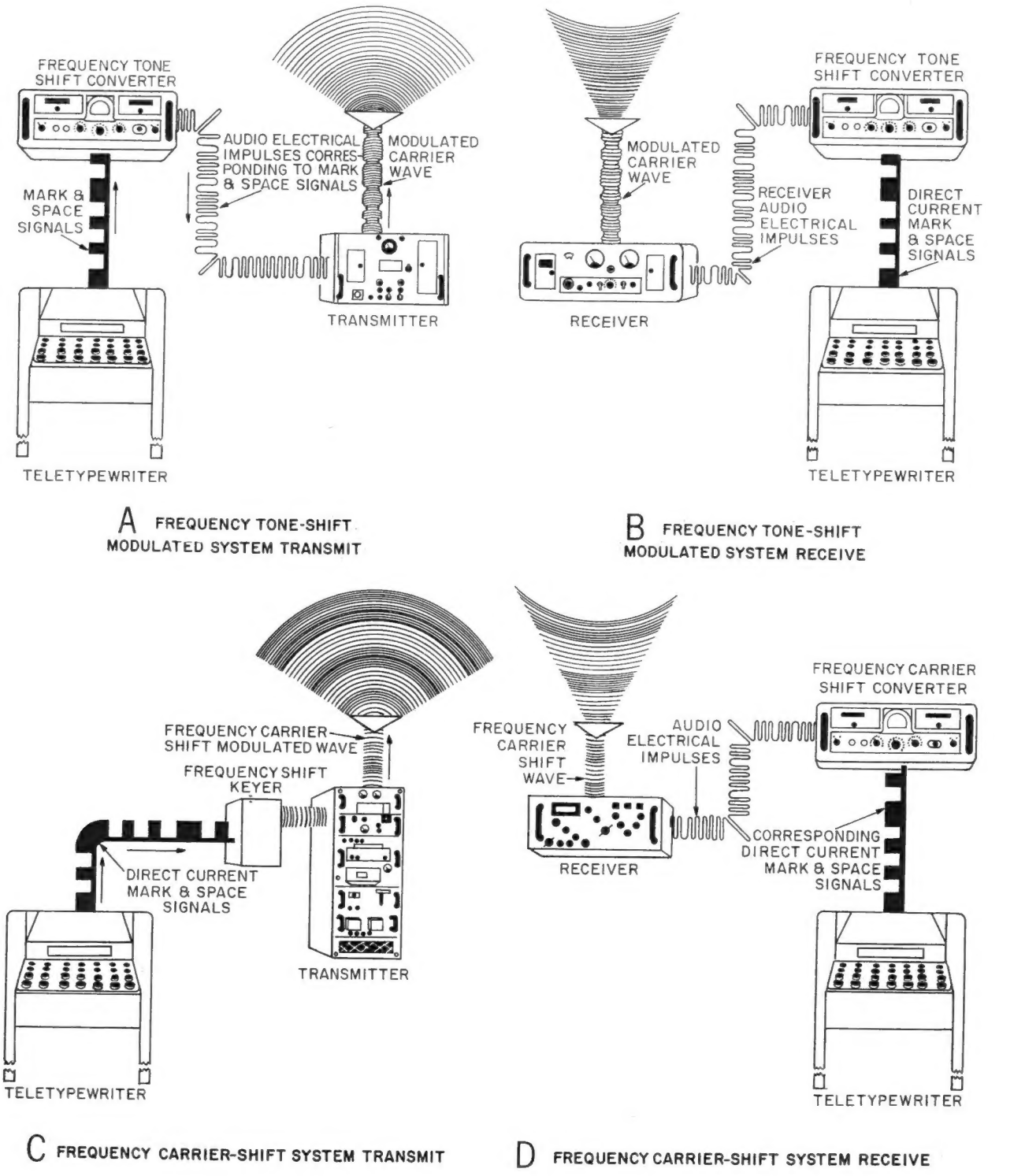


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Figure 4-4.—Tone and frequency shift modulation.

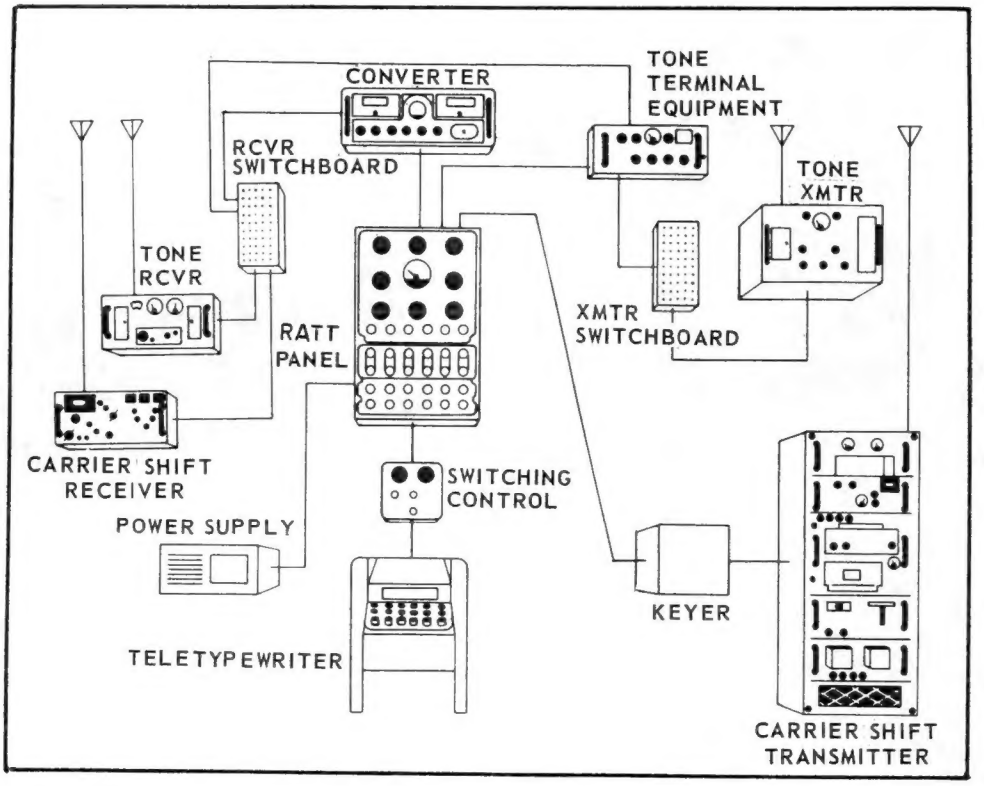

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Figure 4-5.—Integrated RATT system.

TELETYPEWRITER SETS

Most of the teletypewriter sets used by the Navy belong to the model 28 family of teletypewriter equipments. The model 28 equipments feature light weight, small size, quiet operation, and high operating speeds. They present relatively few maintenance problems, and are suited particularly for shipboard use under severe conditions of roll, vibration, and shock.

Another feature of the model 28 teletypewriters is their ability to operate at speeds of 60, 75, or 100 words per minute. Conversion from one speed to another is accomplished by changing the driving gears that are located within the equipment. The majority of the Navy's teletypewriters are presently operated at 100 words per minute.

Teletypewriters may be send-receive units or receive units only. They may be designed as floor model, table model, rack mounted, or wall mounted sets.

Model 28 Send-Receive And Receive Sets

These model 28 send-receive teletypewriter page printers are basically the same. The TT-48( )/UG is a floor model keyboard-sending and page-receiving teletypewriter (fig. 4-6). The TT-48( )/UG provides means for exchanging typewritten page messages between two or more ships or stations that are similarly equipped and connected by a radio (or wire) circuit. While transmitting from the keyboard, monitor copy is presented by the typing unit. Hence, messages cannot be transmitted and received simultaneously.

The TT-47( )/UG is an older floor model still in use, and differs from the TT-48( )/UG by the type of motor used. The TT-47( )/UG

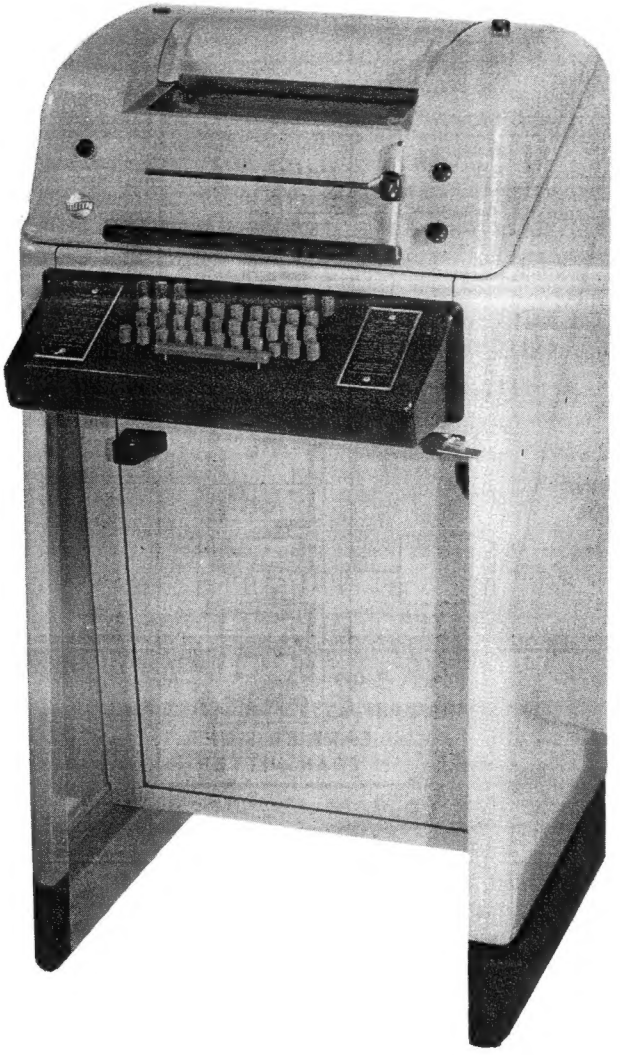

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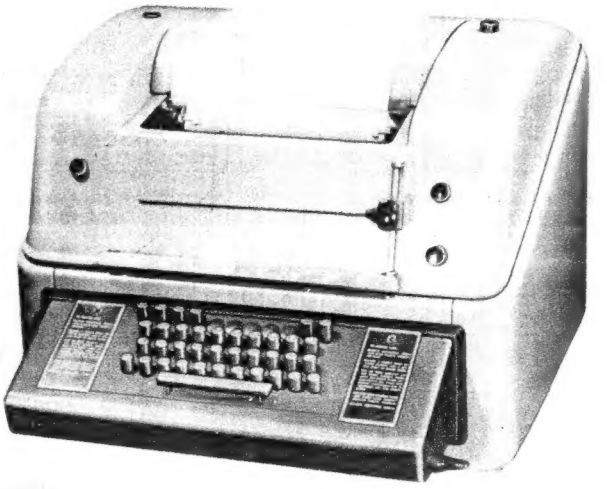
Figure 4-6.—Model 28 Teletypewriter TT-48( )UG.

has a 60 hertz synchronous motor, and the TT-48( )/UG uses a series governed motor.

Another example of modification is the TT-69( )/UG, (fig. 4-7). Except for being installed in a cut-down cabinet, the TT-69( )/UG is like the above equipment. It serves the same purpose, and it functions in the same manner. Usually, the TT-69( )/UG is installed on small ships where space is of prime consideration.

The TT-176A/UG (not illustrated) is like the above equipment except that it is a rack-mounted send-receive teletypewriter.



1.217(76)

Figure 4-7.—Teletypewriter TT-69( )UG.

Rack-mounted units such as, teletypewriter, radio, and sonar equipments are designed narrower in width. They are mounted aboard ships where space is a premium and stand-up operation is necessary.

The AN/UGC-20 (fig. 4-8) is another send-receive teletypewriter which reduces the transmitter keyboard from 32 to 28 typing units.

1.361

Figure 4-8. --Compact Keyboard Send-Receive Teletypewriter AN/UGC-20.

All mechanisms have been mounted to require minimum space. This compact teletypewriter is designed for use where space is of importance.

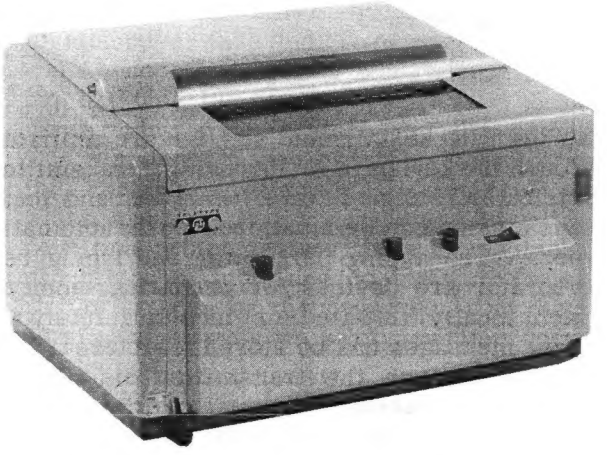
The model 28 receive-only sets are similar to the send-receive sets but have no keyboard sending capabilities. The AN/UGC-25 page printer (fig. 4-9) is a receive-only, compact, table model set seldom found aboard small ships, but used on large ships, chiefly for copying messages from the fleet broadcast.

Teletypewriter Perforator-Reperforator TT-253/UG

An extremely useful teletypewriter equipment is the TT-253/UG (fig. 4-10). Its chief use is for preparing messages in tape form for transmission by automatic means. When connected to an external circuit, however, the machine also can be utilized to transmit and receive messages.

When a character is typed on the keyboard, its corresponding teletype code is perforated in the paper tape. Simultaneous with this action, the character is printed on the tape. In addition, the mark and space combinations for that character are sent from the keyboard directly to the external circuit (if connected).

Signals from the external circuit cause the machine to perform as just described. Thus, the TT-253/UG can be employed for communicating directly with distant stations or for the off-circuit preparation of message tapes. If both tape and printed page copy of a message are desired, the perforator-reperforator is used in conjunction with a page-receiving teletypewriter.



1.362

Figure 4-9.—Compact receive-only Teletypewriter AN/UGC-25.

50.116

Figure 4-10.—Send/Receive Typing Perforator-Reperforator TT-253/UG.

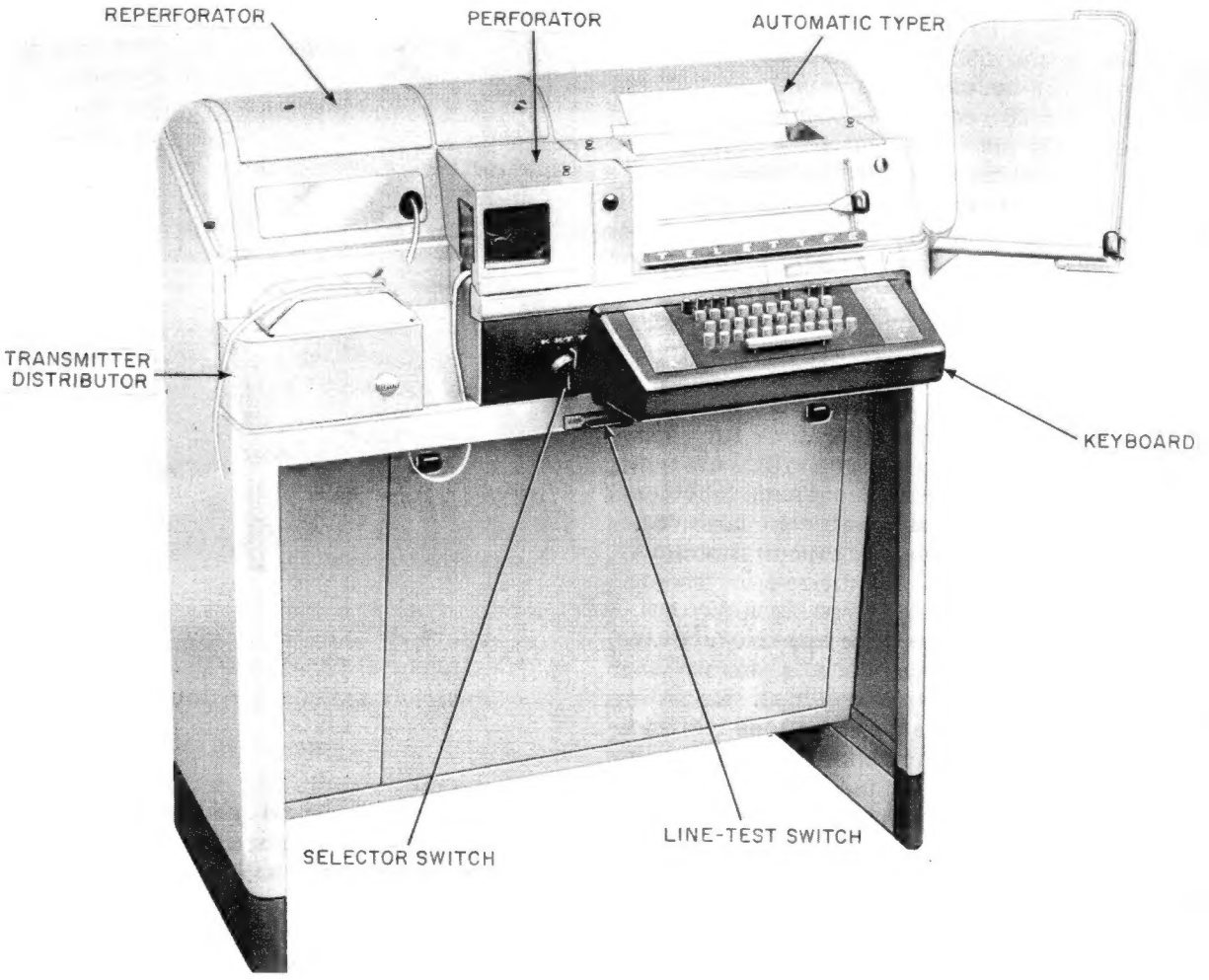
Teletypewriter Reperforator TT-192( )/UG

The TT-192( )/UG (not illustrated) is basically the same as the TT-253/UG just described except for not having a keyboard.

Normally, the reperforator's wiring is terminated in a patch panel (described later in this chapter) so that it can be patched or connected into any teletype circuit wired through the panel. By patching the reperforator into a circuit, a tape copy of each message is obtained, and messages requiring further processing in tape form need not be retyped by the operator.

Teletypewriter Set AN/UGC-6

The AN/UGC-6 teletypewriter (fig. 4-11) is a versatile communication equipment. It receives messages from the signal line and prints them on page size copy paper. In addition, it can receive messages and record them on tape and in printed form. With page-printed monitoring, the teletypewriter transmits



1.217(31)

Figure 4-11.—Teletypewriter AN/UGC-6.

messages that are originated either by perforated tape or by keyboard operation. It mechanically prepares perforated and printed tape for separate transmission with or without simultaneous transmission and page-printed monitoring.

The teletypewriter set is composed of the following components: a cabinet, a keyboard, an automatic typer, a typing perforator, a transmitter distributor, a typing reperforator, and power distribution panels.

In operation, the components are linked by electrical or mechanical connections to offer a wide range of possibilities for sending, receiving, or storing teletypewriter messages. All equipment components are housed in the cabinet. Transmission signals are initiated through the keyboard or through the transmitter distributor. Signals are received, and local transmission can be monitored, on the automatic typer. The typing perforator and typing reperforator are devices for preparing tapes on which locally initiated or incoming teletypewriter messages can be stored for future transmission through the transmitter distributor.

The keyboard, typing perforator, automatic typer, and transmitter distributor are operated by the motor mounted on the keyboard. Selection of these components for either individual or simultaneous operation is by the selector switch located at the front of the cabinet, to the left of the keyboard. All these components are

connected in series in the signal line, but the selector switch has provisions for excluding various components from the line. The external signal line is connected to the equipment through a line-test switch located below the selector switch on the front of the cabinet. This arrangement provides a means of disconnecting the equipment from the line for local testing of the components. The typing reperforator is operated by a separate motor and power distribution system. It also is connected to a separate external signal line.

To become a part of the Naval Tactical Data System (NTDS), the AN/UGC-6 is modified to provide input/output communications with a selected data processing computer.

Teletypewriter AN/UGC-13

The Teletypewriter Set AN/UGC-13 when modified with Adapter becomes a part of the Naval Tactical Data System (NTDS). The adapter (contained in the teletypewriter cabinet, fig. 4-12) modifies data to provide compatibility between a computer and the teletypewriter unit. With the addition of the adapter, not only can the teletypewriter set communicate with other stations, but also can exchange information with the digital-data processing computer.

The teletypewriter keyboard consists of a set of manually operated keys which generate teletypewriter codes. The printing unit may accept teletypewriter codes from the keyboard, transmitter-distributor, or the computer. The transmitter-distributor (fig. 4-12) reads perforated paper tape and converts it into teletypewriter codes which can be transmitted to the printing unit, the typing reperforator, the auxiliary typing reperforator, and the computer. The maintenance and control section produces the control signals and the interrupt codes which are sent to the computer indicating the condition which exists in the adapter. By use of the maintenance controls, the teletypewriter set can be disconnected from the computer and adapter so teletypewriter operation can be tested.

An auxiliary line relay circuit (fig. 4-13) permits the adapter to perform multiplex operation with equipment other than this teletypewriter machine. An auxiliary line relay, built into the teletypewriter cabinet, is connected in the teletypewriter adapter loop. This line relay permits radio link equipment and/or other teletypewriter equipment to be connected into the teletypewriter adapter data loop. Compared to computer operation, the teletypewriter set is a slow-speed device. This permits the computer to perform other functions during the time between teletypewriter codes.

Teletypewriter Projector Unit AN/UGR-1

Teletypewriter projector unit model AN/UGR-1, (fig. 4-14) enables a teletypewriter message to be read simultaneously by groups of persons. It is installed in the pilot ready-rooms in aircraft carriers and in teletypewriter conference rooms ashore.

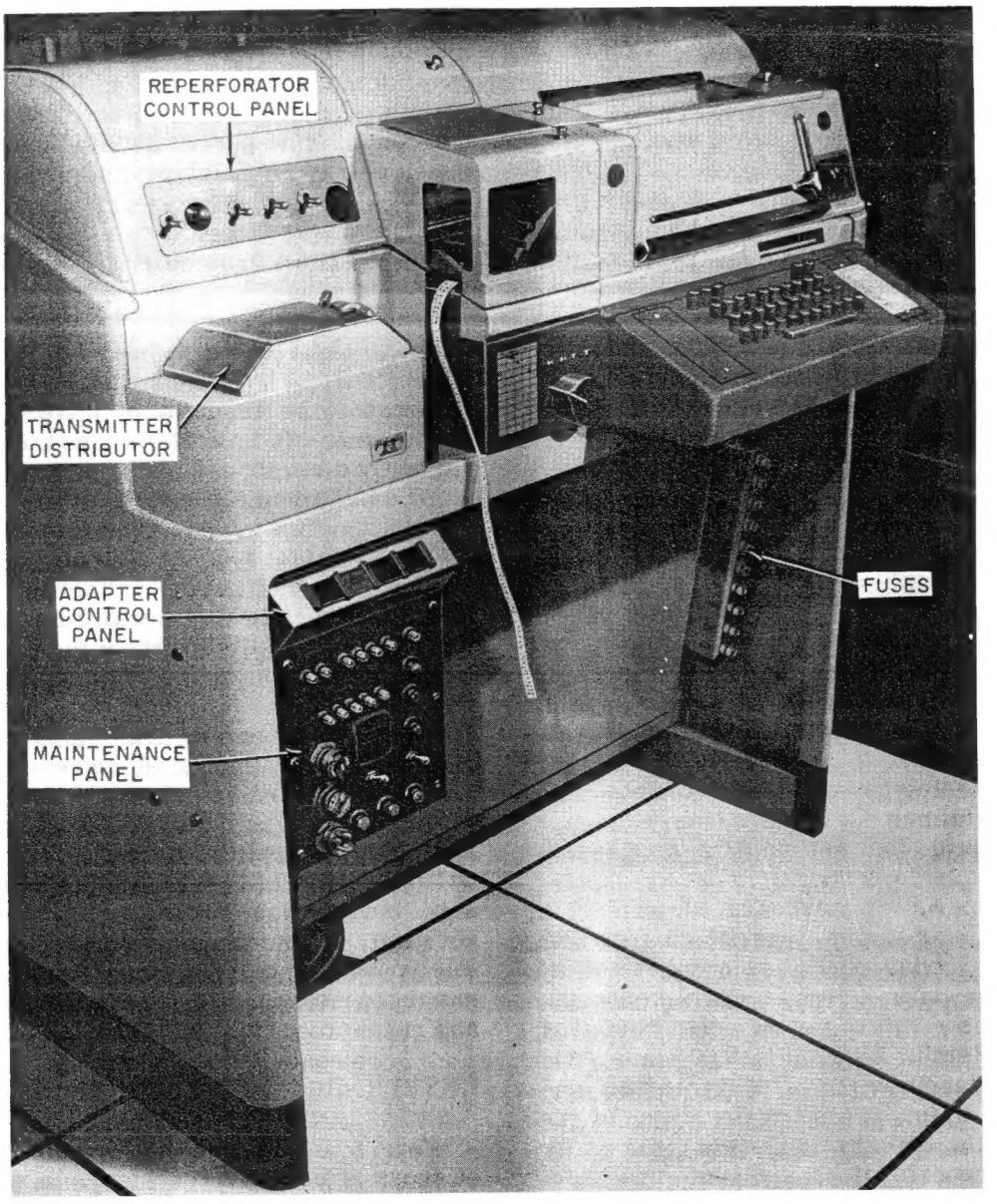
The bottom of the cabinet houses a page-printing teletypewriter. The message is printed on a roll of transparent cellophane. An optical lens system with a powerful lamp enlarges the image of the teletypewriter message and projects it onto a tilted mirror at the top rear of the cabinet from where it is reflected onto the translucent screen. The message is visible along the lower edge of the screen as it is being printed. With each successive line the message advances upward on the screen one line at a time and finally moves out of view at the top. A tape-typing unit provides a permanent typewritten record of transmissions in the projector unit, but at most installations this feature is not used because a page copy from an additional teletypewriter patched into the same circuit has been found to provide a more readable and more convenient file copy.

KEYERS AND CONVERTERS

Keyers and converters are an integral part of every radioteletype system. In some instances, the keyer is built into the radio transmitter, but the converter is a separate piece of equipment.

Tone-Shift Keyer/Converter AN/SGC-1( )

Tone—shift keyer/converter model AN/SGC-1( ) is used for short-range RATT operation. Normally it is used for communication on UHF and VHF bands, but it can be used with any transmitter designed for voice modulation. The AN/SGC-1( ) is shown in figure 4-15, with blocks indicating other equipment necessary for a complete tone-shift system.



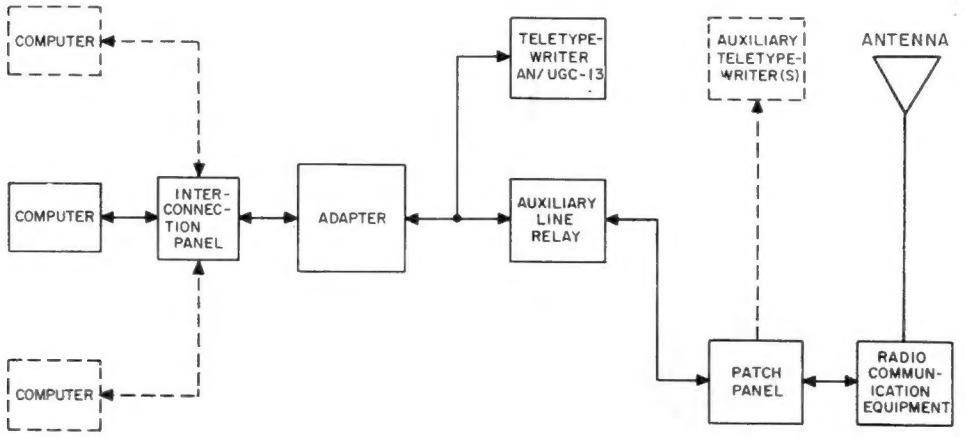
1. 217

Figure 4-12.—Teletypewriter AN/UGC-13 with adapter.

In tone modulation transmission, the teletypewriter pulses are converted into corresponding audio tones, which amplitude modulate the carrier frequency of the transmitter. Conversion to the audio tones is accomplished by an audio oscillator in the tone converter, which operates at 700 hertz when the teletype loop is in a closed-circuit (mark) condition and at 500 hertz when the loop is in an open-circuit (space) condition.

An internal relay in the tone converter closes a control line to the radio transmitter, which places the transmitter on the air when the operator begins typing a message. The control line remains closed until after the message is transmitted.

When receiving messages, the tone converter accepts the mark and space tones coming in from an associated radio receiver and converts the intelligence of the tones into signals



31.29(124)

Figure 4-13.—Teletypewriter system for NTDS.

that close and open the contacts of a relay connected in the local teletypewriter DC loop circuit. This action causes the local teletypewriter to print in unison with the mark and space signals from the distant teletypewriter.

Converter-Comparator Groups AN/URA-8( ) and AN/URA-17( )

The AN/URA-8( ) frequency carrier-shift converter-comparator group (fig. 4-16) is used for diversity reception of RATT and FAX signals. The equipment consists of two frequency shift converters (top and bottom units) and a comparator (middle unit).

For either space diversity or frequency diversity reception, two standard Navy receivers are employed in conjunction with the converter-comparator group. In space diversity operation, the two receivers are tuned to the same carrier frequency, but their receiving antennas are spaced some distance apart. Because of the required spacing between antennas, space diversity usually is limited to shore station use. In frequency diversity operation, the two receivers are tuned to different carrier frequencies that are carrying identical intelligence. Frequency diversity reception commonly is used aboard ship for copying fleet broadcasts, which are keyed simultaneously on several frequencies.

In diversity reception, the audio output of each receiver is connected to its associated frequency shift converter, which converts the frequency shift characters into DC pulses. The DC (or mark-space) pulses from each converter are fed to the comparator. In the comparator, an automatic circuit compares the pulses and selects the better mark and the better space pulse for each character. The output of the comparator is patched to the teletypewriter. The converter units also can be used individually with separate teletypewriters to copy two different FSK signals.

The newest converter-comparator group, the AN/URA-17( ) (fig. 4-17 is a completely transistorized equipment designed to perform the same functions as the AN/URA-8( ). Although present procurement of frequency shift converters is confined to the AN/URA-17( ), there are relatively few installations compared with the larger number of AN/URA-8( ) converters.

The AN/URA-17( ) consists of two identical converter units. Each converter has its own comparator circuitry. Hence, a separate comparator unit is not required. The physical size of the AN/URA-17( ) is further reduced by using transistors and printed circuit boards. The complete equipment is less than half the size of the older AN/URA-8( ).

TELETYPE PATCH PANELS

To provide flexibility in teletype systems, the wiring of all teletypewriter and associated equipments is terminated on jacks in teletype patch panels. The equipment then is connected electrically in any desired combination by means of patching cords (lengths of wire with

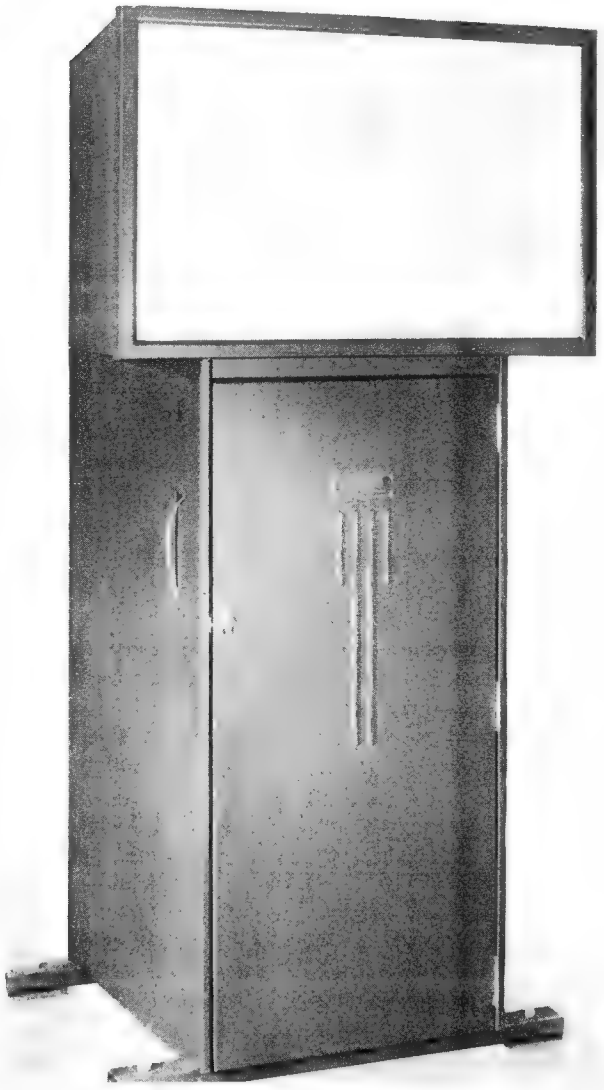


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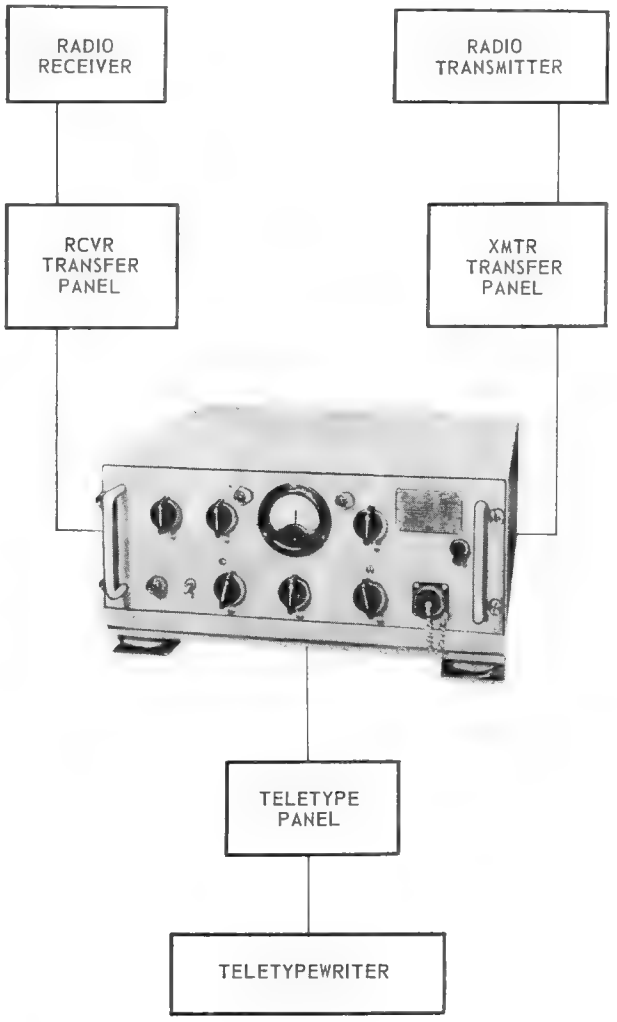
Figure 4-14.—Teletypewriter Projector Unit AN/UGR-1.



1.240

Figure 4-15.—Tone Shift Keyer/Converter AN/SGC-1( ).

plugs on each end). The plugs on the cords are inserted into the jacks at the front of the panel. In some instances, commonly used combinations of equipment are permanently wired together within the panel (called "normal-through"). They are wired in such a manner, however, that the individual pieces of equipment can be "lifted" from the combination, and then used alone or in other combinations.

In addition to providing flexibility, teletype panels also furnish a central point for connecting the DC voltage supply into the teletypewriter circuits. Thus, one source of supply can be used for all circuits passing through a particular panel.

Teletype Panels SB-1203/UG and SB-1210/UGQ

Teletype panels SB-1203/UG and SB-1210/UGQ (fig. 4-18) are used for interconnection and transfer of teletypewriter equipment aboard ship with various radio adapters, such as frequency shift keyers and converters. The SB-1203/UG is a general-purpose panel, whereas

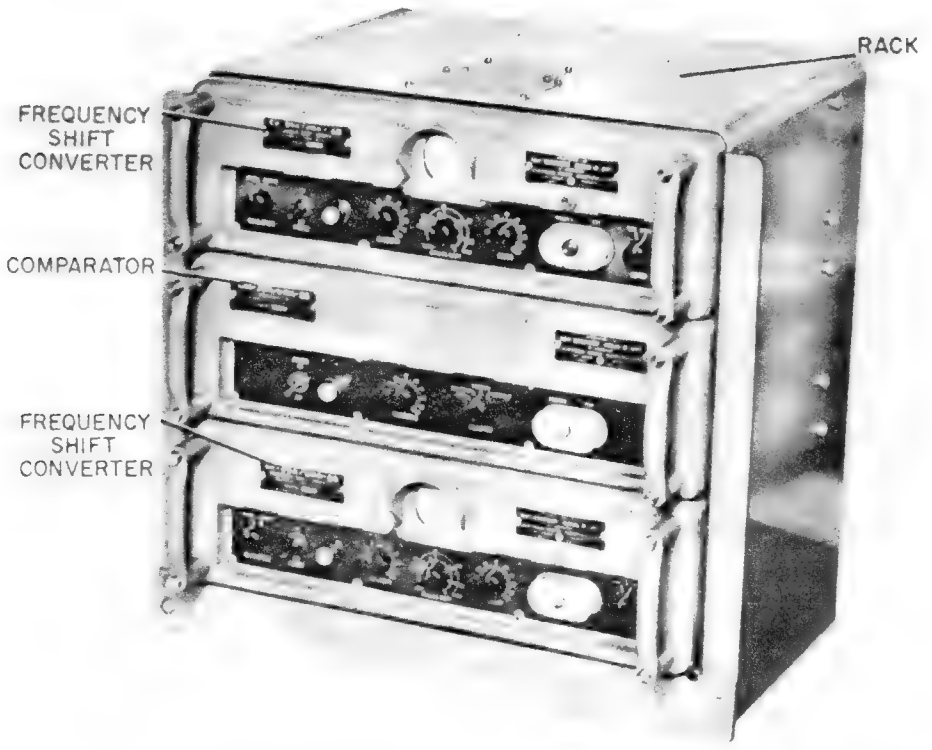


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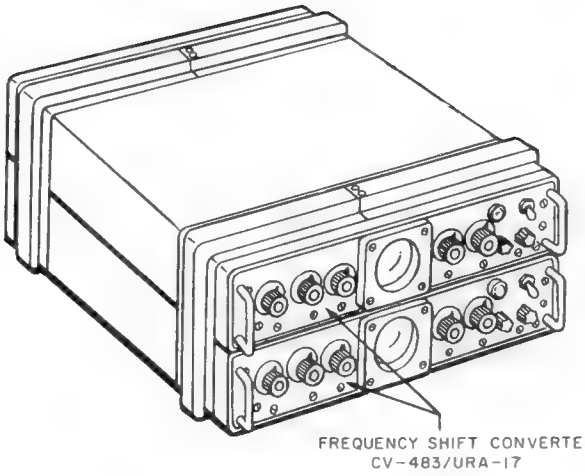
Figure 4-16.—Converter-Comparator Group AN/URA-8( ).



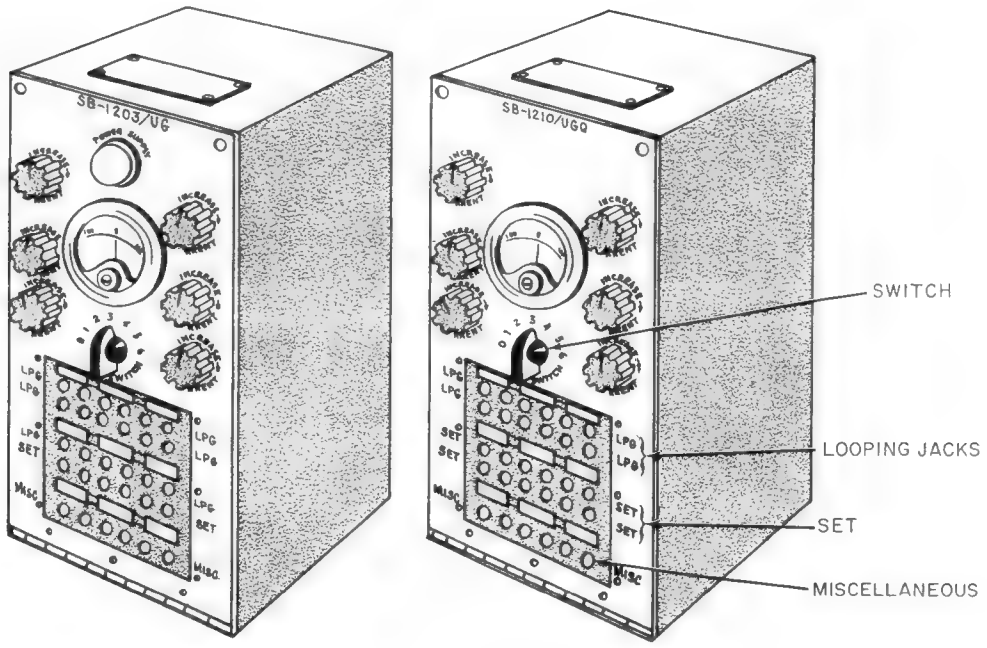
50.76

Figure 4-17.—Converter-Comparator Group AN/URA-17( ).

the SB-1210/UGQ is intended for use with cryptographic devices. The colors RED and BLACK are used to identify crytographic equipments. A patch panel used cryptographically is commonly painted red and has red bands installed or painted on its cables. Black is used to identify a nonsecurity patch panel.

Each of the panels contains six channels, with each channel comprising a looping series circuit of looping jacks, set jacks, and a rheostat for adjusting line current. The number of looping and set jacks in each channel varies according to the panel model. Each panel includes a meter and rotary selector switch for measuring the line current in any channel. There are six miscellaneous jacks to which may be connected any teletypewriter equipment not regularly assigned to a channel.

If the desired teletype equipment is wired in the same looping channel as the radio adapter (keyer or converter) to be used (normal through connection), no patch cords are required. But, if the desired teletypewriter (for example,



70.79

Figure 4-18.—Teletype Patch Panels SB-1203/UG and SB-1210/UGQ.

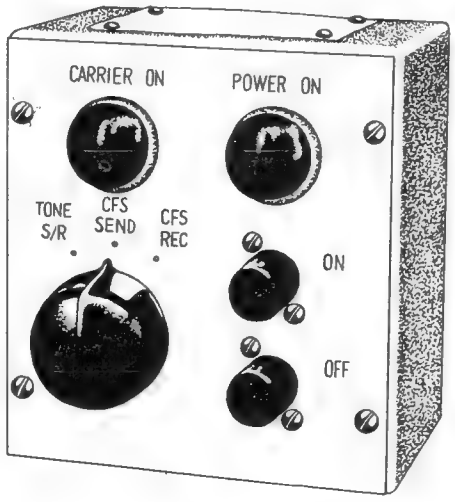
in channel 1) is not wired in the same looping channel as the keyer or converter to be used (for example, channel 3), one end of the patch cord must be inserted in the set jack in channel 1, and the other end in either one of the two looping jacks in channel 3.

In any switching operation between the various plugs and jacks of a teletype panel, the cord plug must be pulled from the looping jack before removing the other plug from the set (machine) jack. Pulling the plug from the set jack first open-circuits the channel, causing all teletype messages in the channel to be interrupted. It may also produce a dangerous DC voltage on the exposed plug.

REMOTE TRANSMITTER CONTROL UNIT C-1004( )/SG

Another piece of equipment used with teletypewriter installations aboard ship is the C-1004( )/SG control unit shown in figure 4-19. This unit is mounted close to the teletypewriter keyboard and permits remote control of the radio transmitter. It has a transmitter power on-off switch, a power-on indicator lamp, a carrier-on indicator lamp, and a three-position rotary selector switch.

The TONE S/R switch position is used for both sending and receiving when using a tone shift keyer converter. When using frequency carrier-shift mode of operation, the operator must switch to SEND position for transmitting and to REC position for receiving.



1.244.1

Figure 4-19.—Remote Control Unit C-1004( )S/G.

MULTIPLEXING

The number of communication networks in operation per unit of time throughout any given area is increasing constantly. In the not-too-distant past, each network was required to operate on a different frequency. As a result, all areas of the radio-frequency spectrum had become highly congested.

The maximum permissible number of intelligible transmissions taking place in the radio spectrum per unit of time can be increased through the use of multiplexing. The main purpose of a multiplex system is to increase the message-handling capacity of radio communication, or teletypewriter channels and the transmitters and receivers associated with them. This increase in capacity is accomplished by the simultaneous transmission of several messages over a common channel. The frequency division multiplexing telegraph terminal employs a number of tone channels slightly displaced in frequency. Each tone channel carries the signals from a separate teletypewriter circuit and modulates a common carrier frequency. Receiving equipment at a distant station accepts the multiplex signals, converts them to mark-space signals, and distributes them in the proper order to a corresponding number of circuits.

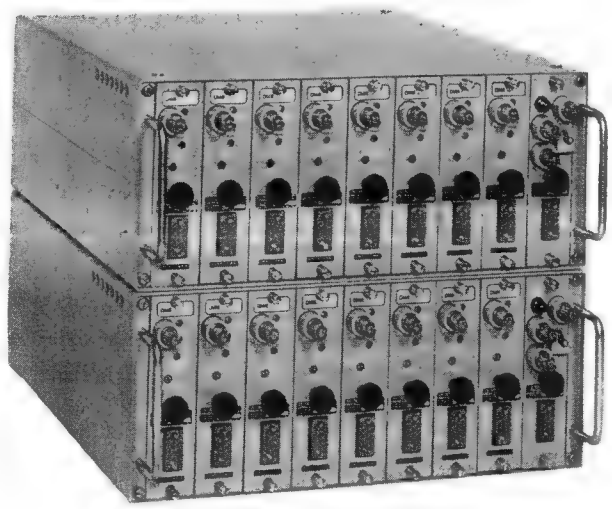
Most of the active fleet is equipped with multiplex equipment.

TELEGRAPH TERMINAL SET AN/UCC-1(V)

Tha AN/UCC-1(V) (fig. 4-20) consists of frequency division multiplex terminal equipment for use with radio (or wire) circuits. The equipment is completely transistorized.

Each of the two electrical cabinets (fig. 4-20) houses one control-attenuator (right-side) for switch control. The module will also have either 8 keyers for transmission, or 8 frequency-shift converters for receiving, or any combination of both.

Each channel has its own keyer and will have one or more converters that will accept a keying speed of 100 WPM. When keyed by teletypewriter signals, the keyers generate one frequency representing a mark and another representing a space (2 modes for each channel). The converters receive the signals and reverse the process performed by the keyers. They accept a particular frequency-shift signal and convert it to the DC marks and spaces for operation of the teletypewriters.



120.26(120C)

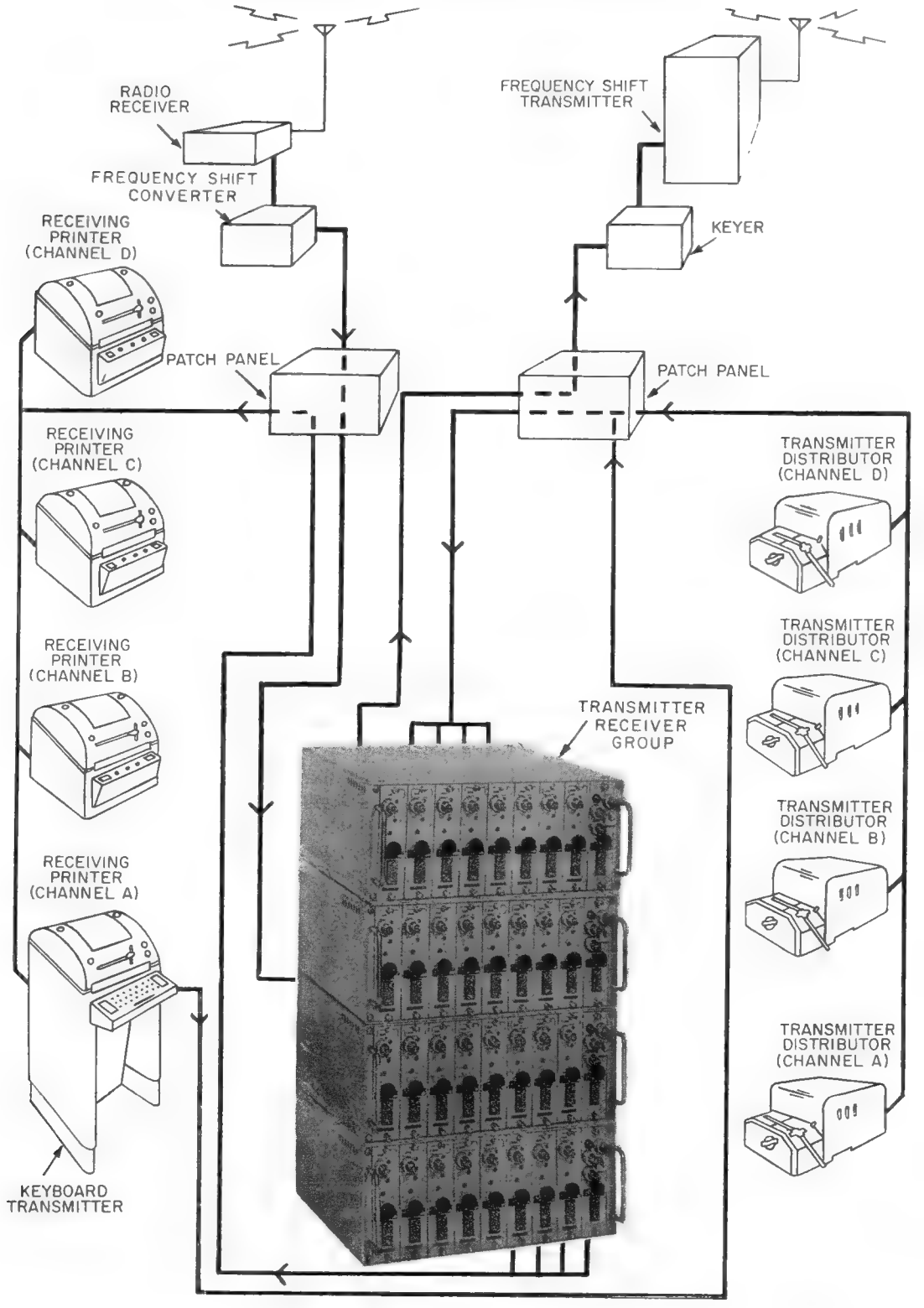
Figure 4-20.—Telegraph Multiplex Terminal AN/UCC-1(V).

Because of its light weight, small size, and high message-handling capacity, the AN/UCC-1(V) is suitable for installation on most types of ships.

A schematic representation of a 4-channel multiplex installation is shown in figure 4-21. The frequency shift transmitter, the keyer, the radio receiver, the converter, the patch panels, and the teletypewriter equipment are included to show the complete send-receive system.

Teletypewriter signals are fed to the terminal equipment's transmitting group from two, three, or four separate circuits. The signaling speed can be 60, 75, or 100 wpm, but the speed must be the same for each circuit. In the transmitting group, the teletypewriter signals are converted to multiplexed signals that are arranged in sequential order for transmission over a single radio circuit. The multiplexed output of the transmitting group is fed through the patch panel and frequency shift keyer to the radio transmitter, where the frequency-shifted multiplex signal is placed on the air.

At the receiving station, the multiplex signals from the radio receiver are processed through the frequency shift converter. Then, they are patched to the receiving group. The receiving



50.83(120C)

Figure 4-21.—Multiplex installation employing 4-channel terminal equipment.

group converts the multiplexed signals back into standard teletypewriter signals and distributes the DC marks and spaces to the proper teleltypewriters.

FACSIMILE

Facsimile (FAX) is a method for transmitting still images over an electrical communication system. The images, called pictures or copy in facsimile terminology, may be weather maps, photographs, sketches, typewritten or printed text, or handwriting. The still image serving as the facsimile copy or picture cannot be transmitted instantly in its entirety. Three distinct operations are performed. These are (1) scanning, (2) transmitting, and (3) recording or receiving.

The scanning operation consists of subdividing the picture in an orderly manner into a large number of elemental segments. This process is accomplished in the facsimile transmitter by a scanning drum and phototube arrangement.

The picture to be transmitted is mounted on a cylindrical scanning drum, which rotates at a constant speed and at the same time moves longitudinally along a shaft. Light from an exciter lamp illuminates a small segment of the moving picture and is reflected by the picture through an aperture to a phototube. During the transmission of a complete picture, the light traverses every segment of the picture as the drum slowly spirals past the fixed lighted area.

At any instant, the amount of light reflected back to the phototube is a measure of the lightness or darkness of the tiny segment of the picture that is being scanned. The phototube transforms the varying amounts of light into varying electrical signals, which, in turn, are used to amplitude modulate the constant frequency output of a local oscillator. Then, the modulated signal is amplified and sent to the radio circuits.

Electrical signals received by the facsimile receiver are amplified and serve to actuate a recording mechanism that makes a permanent recording (segment by segment) on recording paper. The paper is attached to a receiver drum similar to the one in the facsimile transmitter. The receiver drum rotates synchronously with the transmitter drum. This action continues until the original picture is reproduced in its entirety. The recording mechanism may reproduce photographically with a modulated light source shining on photographic paper or film, or it may reproduce directly by burning a white protective coating from specially prepared black recording paper.

Synchronization is obtained by driving both receiving and transmitting drums with synchronous motors operating at exactly the same speed.

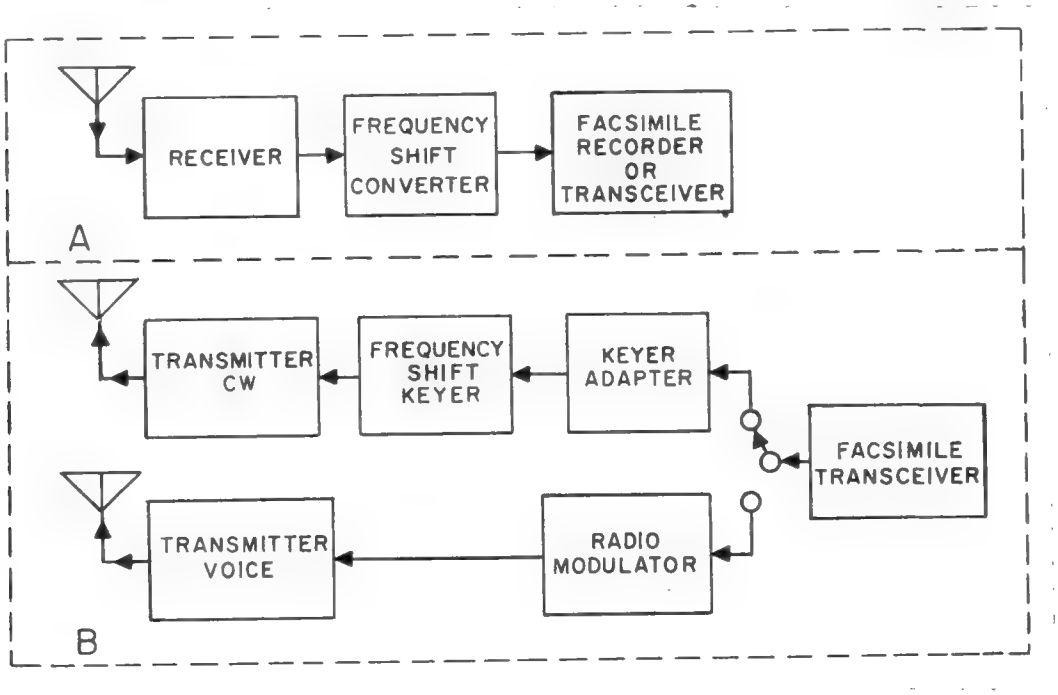
Framing (orienting) the receiver drum with respect to the transmitter drum is accomplished by transmitting a series of phasing pulses just before a picture transmission is to begin. The pulses operate a clutch mechanism that starts the scanning drum in the receiver so that it is phased properly with respect to the starting position of the scanning drum in the transmitter.

The equipment necessary for radio facsimile operation and its relationship to other units in the various receiving and transmitting systems are illustrated by block diagram in figure 4-22. As shown in part A of the figure, the receiving system consists of a standard radio receiver, a frequency shift converter, and a facsimile recorder. Part B shows two systems for transmitting facsimile signals. One, the upper row of blocks, is for long-range, carrier frequency shift transmission and consists of a facsimile transceiver, a keyer adapter, a frequency shfit keyer, and a CW transmitter. The other, the lower row of blocks, is for short-range, audiofrequency shift transmission and employs a facsimile transceiver, a radio modulator, and a voice transmitter.

The equipment discussed in the remaining portion of this chapter is representative of that used in shipboard facsimile installations.

FACSIMILE TRANSCEIVERS TT-41( )/TXC-1B AND TT-321A/UX

Facsimile transceiver TT-41( )/TXC-1B (fig. 4-23), is an electromechanical-optical facsimile set of the revolving-drum type for both transmission and reception of page copy. Colored copy may be transmitted, but all reproduction is in black, white, and intermediate shades of gray. Received copy is recorded either directly on chemically treated paper, or photographically in either negative or positive form. The equipment transmits or receives a page of copy 12 by 18 inches in 20 minutes at

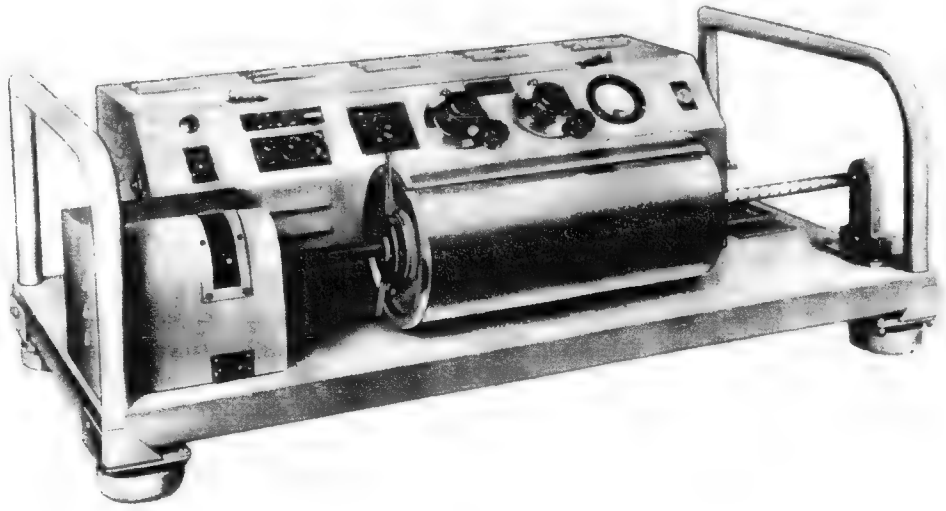


70.14

Figure 4-22.—Radio facsimile systems.

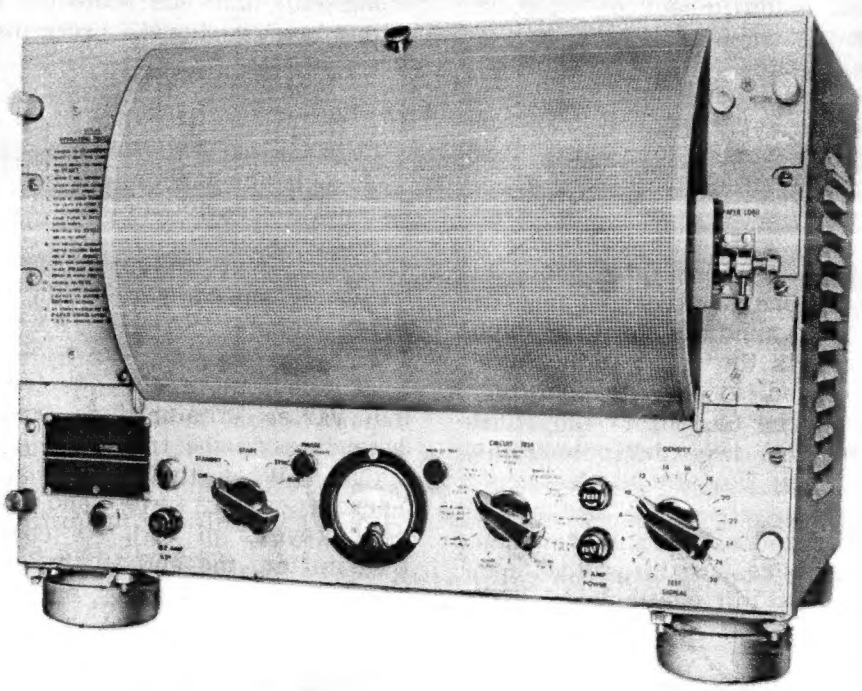
regular speed (60 RPM=LPM), or in 40 minutes with half-speed (30 lines per minute, LPM) operation.

The TT-321A/UX facsimile transceiver, also shown in figure 4-24 is the same transceiver as above but has an increase in motor speed.



13.70

Figure 4-23.—Facsimile Transceiver TT-41( )/TXC-1B and TT-321A/UX.



13.71

Figure 4-24.—Facsimile Recorder RD-92( )/UX.

The TT-321A/UX transmits or receives a page of copy 12 by 18 inches in 10 minutes at regular speed (120 LPM), or in 20 minutes with half-speed (60 LPM) operation.

A facsimile transceiver (or transmitter) generates an amplitude-modulated signal, and the recorder is designed to operate on this type of signal. The signal generated by the transmitter is unsuitable, however, for transmission by means of radio. For this reason, it is necessary to use signal conversion equipment between the facsimile transmitter and the radio transmitter, and between the radio receiver and the facsimile recorder.

FACSIMILE RECORDER RD-92( )/UX

Facsimile recorder RD-92( )/UX, shown in figure 4-24, is used for direct stylus recording only. Unlike the transceivers described earlier, it cannot be used for transmitting facsimile, nor can it be used to receive on photographic film.

When receiving copy, the recorder drum rotates at a speed of 60 rpm. (No provision is made for multispeed operation.) As the drum rotates, a mechanical mechanism holding a stylus needle is moved across the drum to the right. The stylus needle records on paper fastened on the drum at the rate of one scanning line for each revolution of the drum. When the paper is covered completely, from left to right, the stylus is returned automatically to the left side of the drum so that it will be ready to record the next transmitted copy.

This basic RD-92( )/UX facsimile recorder was updated to meet NATO requirements of 60-90-120 LPM by modifying the recorder and using a combined pair of equipments to get desired results. The modified model RD-171( )/UX operates from 60-90 LPM: the RO-160( )/UX operates from 60-120 LPM: and the RD-172( )/UX operates from 90-120 LPM. Any two combinations met requirements of 60-90-120 LPM.

FACSIMILE RECORDER AN/UXH-2B

A more modern facsimile recorder than the one just described is the model AN/UXH-2B shown in figure 4-25. Instead of recording on paper that is attached to a revolving drum, the AN/UXH-2B makes direct recordings across a continuous page of paper. Paper is supplied from a roll within the machine.

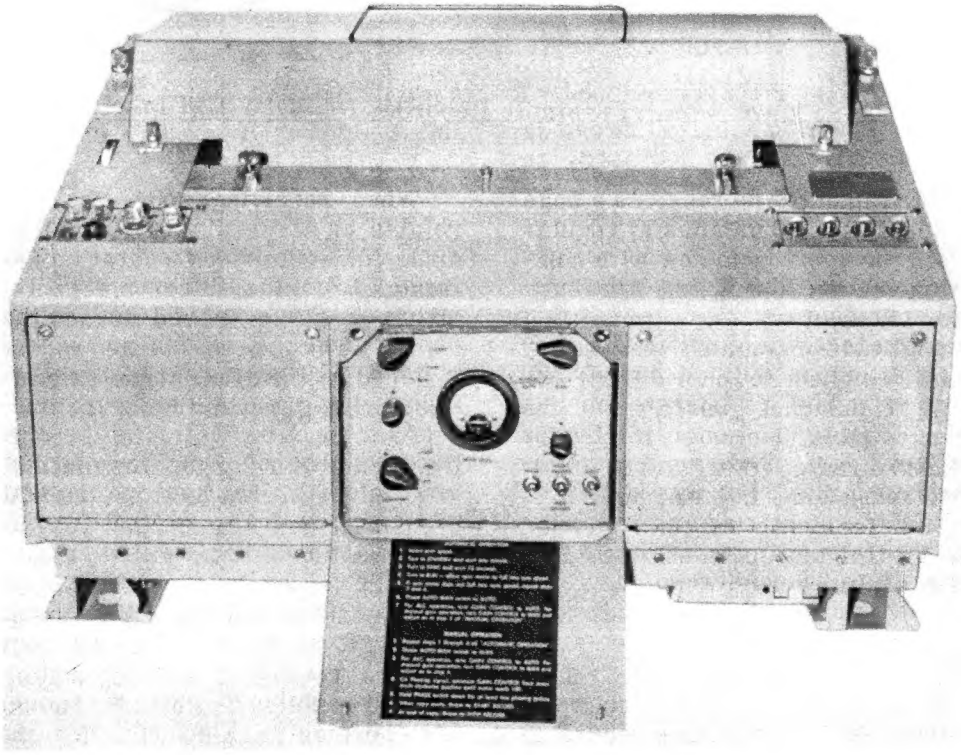
Recording is accomplished by using three recording heads that are carried across the page on a rubber belt. The heads are spaced on the belt so that only one head is touching the paper at any given time, and the speed at which this head moves across the paper is the same as the scanning speed at the transmitter. Recording speeds can be 60, 90, or 120 scans per minute, making this recorder compatible for operation with most Navy facsimile transmitters.

When receiving signals from a transmitter capable of sending the necessary control signals, the AN/UXH-2B can be left unattended. Upon receipt of the proper signals, it automatically phases, starts recording at the beginning of a transmission, stops when the transmission is complete, and compensates for changes in signal level during the recording.

KEYER ADAPTER KY-44( )/FX

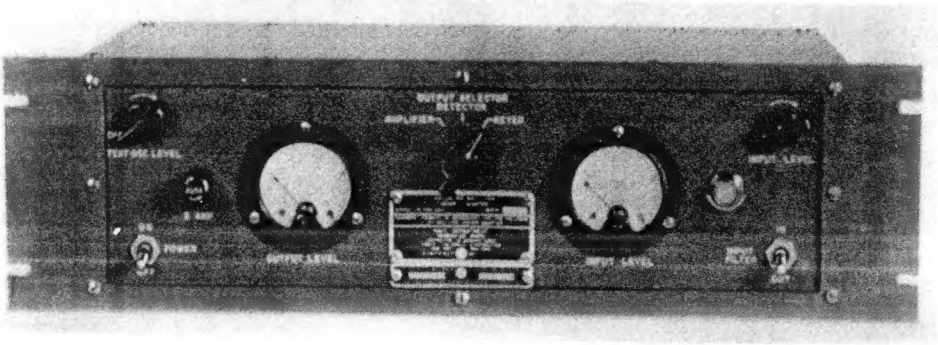
For frequency carrier-shift transmission, the amplitude-modulated audio signal from the facsimile transmitter must be converted to DC keying voltages before being applied to the frequency shift keyer. This is the function of keyer adapter KY-44( )/FX shown in figure 4-26.

The output of the adapter is a DC signal that varies in amplitude from 0 to 20 volts, depending on the frequency of the audio input signal. When the DC signal is used to key a frequency shift keyer, and when the frequency shift keyer, in turn, is controlling a radio transmitter, the end result is transmitted frequency carrier-shift signal similar to a



70.88

Figure 4-25.—Facsimile Recorder AN/UXH-2.



70.81

Figure 4-26.—Keyer Adapter KY-44( )/FX.

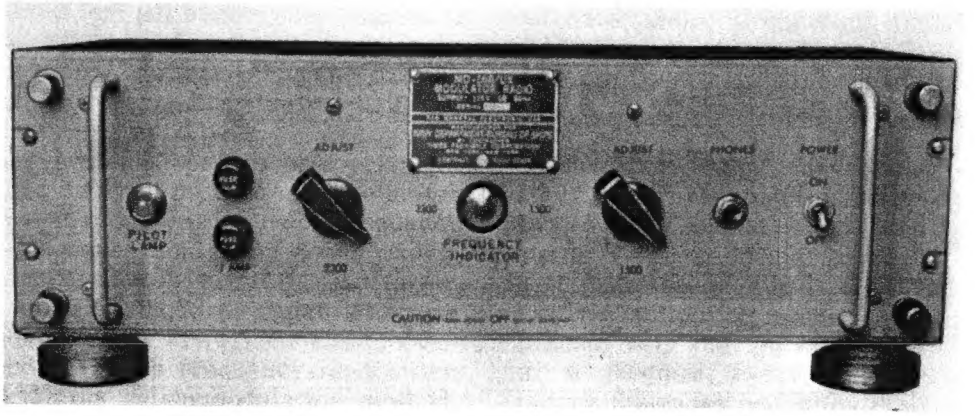
radioteletype signal. As stated previously, this method of transmitting facsimile signals is used for long-range transmissions.

MODULATOR MD-168( )/UX

For transmission of facsimile signals by the audio-frequency shift method, a radio modulator, such as the MD-168( )/UX (fig. 4-27), is required between the facsimile transmitter and the radio transmitter. The modulator converts the amplitude-modulated signal from the facsimile transmitter to constant amplitude frequency modulation, which varies at frequencies between 1500 and 2300 Hz. This frequency variation is used to modulate the radiotelephone transmitter. Modulator MD-168( )/UX can be employed with any transmitter capable of being voice modulated. In general, the audio-frequency shift method is used for short-range transmissions.

FREQUENCY SHIFT CONVERTER CV-172( )/U

With either the frequency carrier shift or the audiofrequency shift methods of transmitting facsimile signals, the output of the radio receiver at the receiving station is an audio-frequency shift signal of constant amplitude. The function of frequency shift converter CV-172( )/U (fig. 4-28) is to convert the receiver's output to an amplitude-modulated signal that varies between 1200 and 2300 Hz. which is



70.82

Figure 4-27.—Modulator MD-168( )/UX.

70.85

Figure 4-28.—Frequency Shift Converter CV-172( )/U.

the signal required for proper operation of the facsimile recorder.

The CV-172( )/U is not the only frequency shift converter used by the Navy in facsimile installations, but it is the one most commonly found aboard ship. Others you may encounter are models CV-97/UX and the CV-1066/UX. They all perform the same function.